Claims

[c1] 1. A method of forming a freestanding semiconductor layer, comprising the steps of:

a) forming a non-monocrystalline mandrel on a monocrystalline base structure;

forming a conformal polycrystalline semiconductor layer on at least one sidewall of the mandrel, the polycrystalline layer contacting the monocrystalline base structure; and

recrystallizing the polycrystalline semiconductor layer to have crystallinity substantially similar to that of the base structure.

[c2] 2. The method of claim 1, wherein step b) further comprises the steps of:

b1) depositing the polycrystalline semiconductor layer on the base structure and the mandrel; and

selectively removing a portion of the polycrystalline semiconductor layer, wherein a remaining portion of the polycrystalline layer contacts at least one sidewall of the mandrel and the base structure.

[c3] 3. The method of claim 1, wherein step b) further comprises the steps of:

b1) growing the polycrystalline semiconductor layer on the base structure and the mandrel; and

selectively removing a portion of the polycrystalline

semiconductor layer.

[c4] The method of claim 1, wherein step c) further comprises the steps of:

c1) removing the mandrel; and

c2) recrystallizing the polycrystalline semiconductor layer through annealing.

[c5] 5. The method of claim 1, wherein step c) further comprises the steps of:

c1) recrystallizing the polycrystalline semiconductor layer through annealing; and

c2) removing the mandrel.

[c6] The method of claim 1, further comprising the step of:

providing an insulating layer.

[c7] The method of claim 6, wherein step a) further comprises the steps of:

a1) forming the base structure on the insulating layer;

a2) depositing the mandrel on the insulating layer and the base structure;

a3) planarizing the mandrel to the base structure; and

a4) selectively removing a portion of the mandrel and the base structure from the insulating layer.

[c8] 8. The method of claim 6, wherein step a) further comprises the steps of:

a1) forming the insulator material on the monocrystalline base structure;

a2) forming at least one aperture in the insulator material; and

a3) forming the non-monocrystalline mandrel on the insulator material and on the base structure, wherein the mandrel contacts the base structure through the at least one aperture.

[c9] The method of claim 8, wherein step b) further comprises the step of:

b1) forming the semiconductor layer on the base structure through the at least one aperture.

[c10] The method of claim 6, wherein the insulator layer and the base structure form a silicon-on-insulator wafer.

[c11] 11. A semiconductor device comprising:

a monocrystalline base structure; and

a conformal monocrystalline freestanding semiconductor layer contacting the monocrystalline base structure, the freestanding semiconductor layer having a crystallinity substantially similar to that of the base structure.

[c12] The device of claim11, further comprising:

an insulator layer on the base structure, the insulator layer and the base structure forming a silicon-on-insulator wafer; and

an aperture in the insulator layer, the freestanding semiconductor layer contacting the base structure through the

aperture.

[c13] The device of claim 11, further comprising:
a silicon-on-insulator wafer having an insulator layer, the base structure and the freestanding semiconductor layer formed on top of the insulator layer.

[c14] The device of claim 11, wherein the base structure is a bulk-substrate silicon wafer.

[c15] The device of claim 11, further comprising:
a non-monocrystalline mandrel, wherein the freestanding semiconductor layer is formed from the non-monocrystalline mandrel.

[c16] 16. A method of forming a field-effect transistor having at least one freestanding semiconductor layer comprising the steps of:
a) forming a non-monocrystalline mandrel on a monocrystalline base structure;
b) forming a conformal polycrystalline semiconductor layer on at least one sidewall of the mandrel, the polycrystalline layer contacting the monocrystalline base structure;
recrystallizing the polycrystalline semiconductor layer to have a crystallinity substantially similar to that of the base structure;
d) removing the mandrel; and
e) forming a gate structure on the semiconductor layer.

[c17] 17. The method of claim 16, wherein step b) further comprises

the steps of:

b1) depositing the polycrystalline semiconductor layer on the base structure and the mandrel; and

b2) selectively removing a portion of the polycrystalline semiconductor layer, wherein a remaining portion of the polycrystalline layer contact at least one sidewall of the mandrel and the base structure.

[c18] 18. The method of claim 16, wherein step b) further comprises the steps of:

b1) growing the polycrystalline semiconductor layer on the base structure and the mandrel; and

b2) selectively removing a portion of the polycrystalline semiconductor layer.

[c19] 19. The method of claim 16, wherein step a) further comprises the steps of:

a1) providing an insulator layer;

a2) forming the base structure on the insulating layer;

a3) depositing the mandrel on the insulating layer and the base structure;

a4) planarizing the mandrel to the base structure; and

a5) selectively removing a portion of the mandrel and the base structure from the insulating layer.

[c20] The method of claim 16, wherein step a) further comprises the steps of:

a1) providing an insulator material;

a2) forming the insulator material on the monocrystalline base structure;

a3) forming at least one aperture in the insulator material; and

a4) forming the non-monocrystalline mandrel on the insulator material and on the base structure, wherein the mandrel contacts the base structure through the at least one aperture.